AIR PERMIT APPLICATION

Delaware City Refining Company LLC., Delaware City, Delaware

Application for an Air Permit for the DCRC CCU SCR Project

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Environmental Resources Management
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1.0 INTRODUCTION

Delaware City Refining Company, LLC (DCRC) owns and operates a petroleum refinery in Delaware City, Delaware. DCRC proposes to install selective catalytic reduction (SCR) controls on two existing combined cycle units (CCUs), which include combustion turbines (CTs) with heat recovery steam generators (HRSG) located at the Delaware City Power Plant (DCPP). This project will result in a significant reduction in nitrogen oxide (NO_x) emissions from the facility. For the purposes of this application, the project will be referred to as the "DCRC CCU SCR Project."

The proposed DCRC CCU SCR Project is fully described in this permit application submitted to the DNREC by DCRC. The purpose of this project is pollution control and will support the DCRC's efforts to reduce facility NO_x emissions. To accomplish a reduction of NO_x at the combine cycle units (CCUs), SCR controls will be installed.

DCRC has evaluated the emission impacts from the installation of these controls and has determined that Prevention of Significant Deterioration (PSD) and nonattainment New Source Review (NANSR) regulations do not apply to this project.

1.1 FACILITY NO_X EMISSIONS

The Delaware City Refinery is subject to a facility-wide NO_2 PAL and NO_x cap.

As described in Section I.A.5 of the May 31, 2010 Agreement:

> "Consistent with federal New Source Review regulatory provisions promulgated by EPA under the [Clean Air Act], DNREC has interpreted Regulation 1125 as affording DNREC the authority to establish facility-wide emission limitations for specific pollutants as the permitting mechanism for ensuring a facility's compliance with New Source Review requirements."

The NO_2 and NO_x emissions associated with the DCRC CCU SCR Project will be subject to the facility-wide limits.

1.2 COMBINED CYCLE UNIT NO_X REDUCTION

DCRC seeks to install SCR controls on the CCUs in order to reduce NO_x emissions from the facility. Specifically, the changes to occur as part of this project include:

- Installation of modularized catalyst beds in the existing HRSG exhaust duct;
- Installation of reagent distribution headers; and
- Addition of an ammonia vaporizer along with aqueous ammonia metering facilities and automatic controls.

These changes are discussed further in Section 2.0.

1.3 PROPOSED PROJECT PERMITTING

This permit application document describes the projected emission impacts and regulatory analysis related to the DCRC CCU SCR Project. A detailed description of the project and the related air emissions, along with the relevant regulatory analyses, are provided in Sections 2 through 5. Proposed permit conditions are provided in Section 6. Additional project-related information is provided in the attachments as follows:

- AQM application forms (Attachment A); and
- Refinery Plot Plan/P&IDs/Site Location Map (Attachment B).

2.0 DCRC CCU SCR PROJECT OVERVIEW

The implementation of the project will allow DCRC to reduce NO_x emissions from the CCUs through the use of SCR controls.

2.1 SELECTIVE CATALYTIC REDUCTION

According to the Environmental Protection Agency's Air Pollution Control Technology Fact Sheet (EPA-452/F-03-032), "SCR is capable of NO_x reduction efficiencies in the range of 70% to 90%". SCR works by injecting a controlled quantity of ammonia into the exhaust gas stream from the CCUs. This stream is then passed over a metal oxide zeolite catalyst. The zeolite catalyzes the reduction of NO_x to nitrogen and water as shown by the following reactions:

$$6NO + 4NH_3 \rightarrow 5N_2 + 6H_2O$$

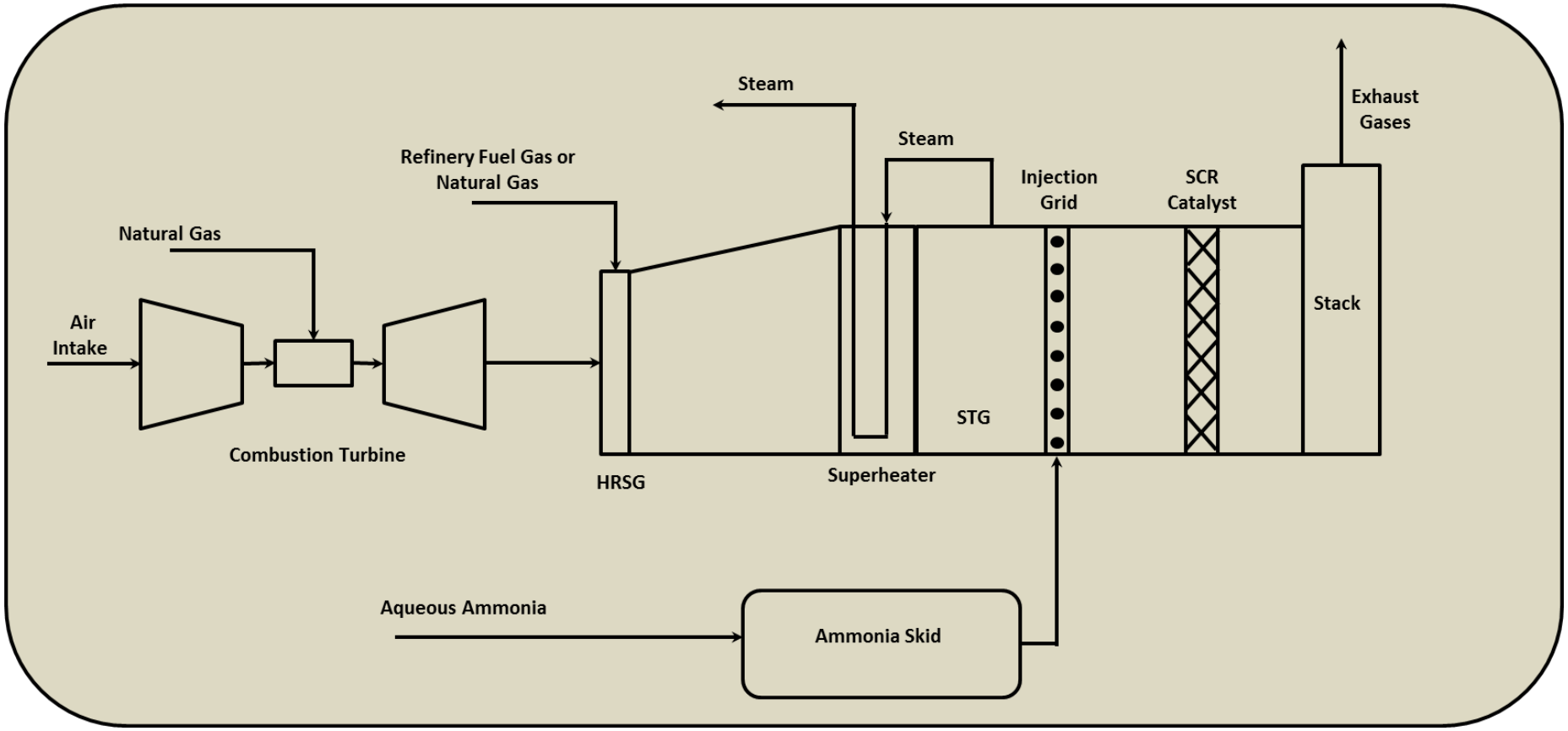
$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$

$$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$$

$$NO + NO_2 + 2NH_3 \rightarrow 2N_2 + 3H_2O$$

An overall process flow diagram has been included as Attachment B. Figure 2-1 below shows a simplified overall process flow diagram for the DCRC CCU SCR Project.

Figure 2-1 DCRC CCU SCR Project Overall Process Flow Diagram



2.2 *COMBINED CYCLE UNITS*

The DCPP is currently permitted to operate two CCU units, which produce power and steam under permit APC-97/0503-Construction (Amendment 8) (NSPS). There are two existing CTs associated with the CCU system with a design capacity of 780 MMBtu/hr each and utilize natural gas (NG) as the primary fuel. Each CCU also includes a HRSG with a capacity of 192 MMBtu/hr each which burn either refinery fuel gas (RFG) or NG as the primary fuel.

2.3 *AQUEOUS AMMONIA STORAGE TANKS*

As part of the proposed project, DCRC will install piping in order to utilize existing aqueous ammonia storage located near the Unit 22 Fluidized Coker to supply the SCR controls. Engineering is evaluating the existing pumping capacity of the ammonia delivery system. Pump upgrades may be included in the project scope to ensure adequate supply of ammonia to the CCUs.

3.0 DETAILED PROJECT EMISSIONS ANALYSIS

This section describes the calculations and assumptions made to estimate the emissions associated with the project.

3.1 CCU NO_X EMISSIONS

Current NO_x permit limits for CCU firing of NG only without duct firing and CCU firing of NG and RFG with duct firing are 15 and 18 parts per million by volume dry (ppmvd) corrected to 15% oxygen (O_2), respectively. The expected NO_x emissions control efficiency as a result of the SCR control installation is approximately 80%. Expected NO_x emission concentrations are compared to permitted limits in Table 3-1.

Table 3-1 Expected CCU SCR Project NO_x Emissions

Scenario	CCU without duct firing (NG only)	CCU with duct firing (NG and RFG)	Startup & Shutdown
Permit Limits (w/o SCR)	15 ppmvd @ 15% O_2	18 ppmvd @ 15% O_2	390 ppmvd @ 15% O_2 (maximum 2 hours)
Expected Emissions (w/ SCR)	3.0 ppmvd @ 15% O_2	3.6 ppmvd @ 15% O_2	390 ppmvd @ 15% O_2 (maximum 2 hours)

The total expected reduction in potential NO_x emissions can be calculated using the equations below:

CCU NO_x emission rate before control:

$$\frac{18\ ppmvd}{10^6} * \frac{46.01\ lb}{lbmol} * \frac{lbmol}{385.5\ scf} * \frac{420{,}000\ scf}{min} * \frac{60\ min}{hour} * \frac{(20.9\ -12.6)}{(20.9-15)} = 76.2\ lb/hour$$

CCU NO_x potential emissions before control:

$$\frac{76.2\ lb}{hour} * \frac{8{,}760\ hours}{year} * \frac{ton}{2{,}000\ lb} = 333.6\ tons\ per\ year\ per\ CCU$$

CCU NO_x emission rate post SCR control:

$$18\ ppmvd,\ inlet\ *(1-80\%) = 3.6\ ppmvd,\ post\ SCR\ control$$

$$\frac{3.6\ ppmvd}{10^6} * \frac{46.01\ lb}{lbmol} * \frac{lbmol}{385.5\ scf} * \frac{420{,}000\ scf}{min} * \frac{60\ min}{hour} * \frac{(20.9-12.6)}{(20.9-15)} = 15.2\ lb/hour$$

CCU NO_x potential emissions post SCR control:

$$\frac{15.2\ lb}{hour} * \frac{8{,}760\ hours}{year} * \frac{ton}{2{,}000\ lb} = 66.7\ tons\ per\ year\ per\ CCU$$

CCU NO_x potential emissions post SCR control:

$$\left(333.6\ \frac{tons}{year} - 66.7 \frac{tons}{year}\right) * 2\ CCUs = 533.7\ \frac{tons}{year} of\ potential\ NO_x\ emissions\ reductions$$

Based on the expected control efficiency of the SCR control, the total expected reduction in potential NO_x emissions will be approximately 533.7 tons per year (TPY).

3.2 CCU SULFURIC ACID MIST EMISSIONS

Based on the SCR vendor's experience, DCRC has reevaluated the potential emissions for sulfuric acid mist (H_2SO_4) due to the conversion of sulfur in fuels (natural gas and refinery fuel gas) to H_2SO_4. Vendor estimates indicate the expected conversion of sulfur in fuels is 90% by weight to sulfur dioxide (SO_2) and 10% by weight to H_2SO_4.

The total expected H_2SO_4 emissions can be calculated using the equations below:

CCU natural gas H_2SO_4 emission rate:

$$\frac{2\ scf\ H_2S}{10^6\ scf\ NG} * \frac{scf\ NG}{1{,}020\ Btu} * \frac{10^6\ Btu}{MMBtu} * \frac{mol\ H_2S}{385.5\ scf\ H_2S} * \frac{0.1\ mol\ H_2SO_4}{1\ mol\ H_2S} * \frac{98.07\ lb\ H_2SO_4}{mol\ H_2SO_4}$$
$$= 4.99 * 10^{-5}\ lb\ H_2SO_4/MMBtu$$

CCU refinery fuel gas (RFG) H_2SO_4 emission rate:

$$\frac{196.7\ scf\ S}{10^6\ scf\ RFG} * \frac{scf\ RFG}{1{,}068.9\ Btu} * \frac{10^6\ Btu}{MMBtu} * \frac{mol\ S}{385.5\ scf\ S} * \frac{0.1\ mol\ H_2SO_4}{1\ mol\ S} * \frac{98.07\ lb\ H_2SO_4}{mol\ H_2SO_4}$$
$$= 0.0047\ lb\ H_2SO_4/MMBtu$$

CCU H_2SO_4 potential emissions:

$$\left(\left(\frac{4.99 * 10^{-5}\ lb\ H_2SO_4}{MMBtu} * \frac{780\ MMBtu}{hour}\right) + \left(\frac{0.0047\ lb\ H_2SO_4}{MMBtu} * \frac{192\ MMBtu}{hour}\right)\right)$$
$$* \frac{8{,}760\ hours}{year} * \frac{tons}{2{,}000\ lb} = 4.1\ tons\ per\ year\ per\ CCU$$

The baseline actual (24-month average) H_2SO_4 emissions for each CCU are shown in Table 3-2 below. These values are based upon the most recent available stack test results.

Table 3-2 Past Actual H_2SO_4 Emissions from CCUs

Month	CCU 1 H_2SO_4 Emissions (tons)	CCU 2 H_2SO_4 Emissions (tons)	Total H_2SO_4 Emissions (tons)
Oct-11	0.59	0.15	0.74
Nov-11	0.25	0.14	0.39
Dec-11	0.30	0.09	0.39
Jan-12	0.45	0.04	0.49
Feb-12	0.25	0.07	0.32
Mar-12	0.16	0.06	0.22
Apr-12	0.14	0.08	0.23
May-12	0.19	0.05	0.24
Jun-12	0.34	0.09	0.42
Jul-12	0.41	0.10	0.51
Aug-12	0.40	0.14	0.54
Sep-12	0.13	0.12	0.26
Oct-12	0.25	0.04	0.30
Nov-12	0.10	0.00	0.10
Dec-12	0.04	0.11	0.16
Jan-13	0.11	0.16	0.27
Feb-13	0.09	0.12	0.21
Mar-13	0.07	0.17	0.24
Apr-13	0.04	0.17	0.20
May-13	0.15	0.17	0.32
Jun-13	0.11	0.16	0.27
Jul-13	0.14	0.17	0.31
Aug-13	0.14	0.16	0.30
Sep-13	0.12	0.00	0.12
Oct 11 - Sept 12 (TPY)	3.62	1.13	4.75
Oct 12 - Sept 13 (TPY)	1.35	1.42	2.78
24-month average (TPY)			3.76

Table 3-3 below shows the baseline actual H_2SO_4 emissions compared to the revised potential to emit (PTE) of the CCUs based on vendor SCR experience. To account for the revised H_2SO_4 PTE, this application reflects the difference between the baseline actual emissions and the revised PTE of the CCUs as an emissions increase.

Table 3-3 H_2SO_4 Emissions Increase from CCUs

Source	Past Actual H_2SO_4 Emissions (TPY)	H_2SO_4 Revised Potential to Emit (TPY)[1]	DCRC CCU SCR Project H_2SO_4 Emissions Increase (TPY)
CCU 1/CCU 2	3.76	8.21	4.45

[1] The revised PTE is 4.1 TPY per CCU.

3.3 AMMONIA SLIP

DCRC will inject ammonia as part of the proposed SCR system for NO_x control of the CCUs through a grid located upstream of the catalyst. The catalyst bed provides active sites where, as the gases pass through the bed, ammonia reacts with NO_x in the exhaust stream. Unreacted ammonia that passes through the catalyst and is emitted to the atmosphere is known as ammonia slip. DCRC expects the ammonia slip to be no more than 10 ppmvd corrected to 15% O_2.

The total expected potential NH_3 emissions can be calculated using the equations below:

CCU NH_3 emission rate:

$$\frac{10\ ppmvd}{10^6} * \frac{17.031\ lb}{lbmol} * \frac{lbmol}{385.5\ scf} * \frac{420{,}000\ scf}{min} * \frac{60\ min}{hour} * \frac{(20.9\ -12.6)}{(20.9-15)} = 15.7\ lb/hour$$

CCU NH_3 potential emissions:

$$\frac{15.7\ lb}{hour} * \frac{8{,}760\ hours}{year} * \frac{ton}{2{,}000\ lb} = 68.6\ tons\ per\ year\ per\ CCU$$

Based on the expected NH_3 slip, the total expected potential NH_3 emissions will be approximately 68.6 TPY per CCU.

4.0 PSD & NANSR REGULATORY OVERVIEW

DCRC must comply with all federal and state requirements applicable to this proposed project. The existing facility is a major stationary source for all criteria pollutants; therefore, the new source must undergo a new source review analysis.

The DCRC facility is located in an area treated as severe nonattainment for ozone and nonattainment for $PM_{2.5}$. It is designated as attainment for all other criteria pollutants. Because of the above designations, DCRC must evaluate this project related activities for the applicability of the Nonattainment NSR (NANSR) program for volatile organic compounds (VOC), NO_x, and particulate matter less than 2.5 microns ($PM_{2.5}$ emissions), and the applicability of the Prevention of Significant Deterioration (PSD) program for nitrogen dioxide (NO_2), SO_2, carbon monoxide (CO), particulate matter (PM), and particulate matter less than 10 microns (PM_{10}). Under the NANSR program, the modification is major for ozone if the VOC or NO_x emissions exceed 25 TPY over the contemporaneous time period. For $PM_{2.5}$, the modification is considered major if the project emissions exceed 10 TPY $PM_{2.5}$ (or 40 TPY SO_2 [$PM_{2.5}$ precursor]). Under PSD, a major modification occurs when NO_2 or SO_2 emissions exceed 40 TPY, CO emissions exceed 100 TPY, PM emissions exceed 25 TPY, PM_{10} emissions exceed 15 TPY, sulfuric acid mist emissions exceed 7 TPY, or lead emissions exceed 0.6 TPY.

Additionally for ozone precursor emissions, there is a special provision, under the definition of "major stationary source" in Regulation No. 1125, Section 2.2 (D). For ozone precursors, the term "installation" is defined to mean "an identifiable piece of process, combustion, or incineration equipment." This definition of major source means that the Regulation No. 1125, Section 2 applicability test must be performed at two levels (i.e., for each identifiable piece of equipment and for the source as a whole). This is known as the "Dual Source" definition of a stationary source and it requires a separate evaluation of each identifiable piece of equipment being constructed or modified and an evaluation of the source as a whole (i.e., all pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous properties, and are under common control). DCRC's approach to assessing the applicability of Regulation No. 1125, Section 2 follows this approach. This treatment is both consistent with the definitions in Delaware's regulations and with the examples of dual source applicability found in U.S. EPA's Draft 1990 New Source Review Workshop Manual. Applying the same logic to this project, each modified process unit is a source and the entire refinery (i.e., the collection of all

emissions units at the refinery) is also a source. A dual source analysis for ozone precursor emissions from the affected units is included in this section.

4.1 PREVENTION OF SIGNIFICANT DETERIORATION ANALYSIS

The Prevention of Significant Deterioration regulations (40 CFR 52.21) are Federal regulations that apply to new major sources or "major modifications" of existing "major stationary sources" located in attainment or unclassifiable areas for a given pollutant. The PSD regulations are enforced by DNREC in accordance with Delaware Regulation 1125. The Delaware City Refinery is a major stationary source, and adding a new source to the facility source that would result in a "significant net emissions increase" would trigger PSD applicability.

The DCRC CCU SCR Project only seeks to increase the potential emissions of H_2SO_4 based on vendor experience with H_2SO_4 formation from sulfur in fuels used in CCUs equipped with SCR controls.

As indicated in the Table 4-1, the H_2SO_4 emissions for the proposed project do not exceed the PSD threshold; therefore, a netting analysis over the contemporaneous period is not required.

Table 4-1 PSD Emissions Analysis

Emissions	Pollutant (TPY)							
	SO_2	CO	PM	PM_{10}	H_2SO_4	H_2S	Lead	CO_2e
DCRC CCU SCR Project	0	0	0	0	4.45	0	0	0
PSD Significant Level	40	100	25	15	7	10	0.6	75,000
PSD Triggered (Before Netting Analysis)	No	No	No	No	No	No	No	No

4.2 NONATTAINMENT NEW SOURCE REVIEW ANALYSIS

This pollution control project will not result in any emissions increases of regulated Nonattainment new source review (NSR) pollutants. In addition, no process at the refinery will be debottlenecked due to the proposed project and no changes to any processes upstream or downstream of the CCUs are proposed as part of the proposed DCRC CCU SCR Project.

5.0 APPLICABLE STANDARDS FOR THE DCRC CCU SCR PROJECT

The CCUs are the only source potentially affected by this project. All other sources will continue to meet their existing permitted limits and requirements. Table 5-1 summarizes the potentially applicable requirements identified for the project.

Table 5-1 Delaware and Federal Applicable Requirements – DCRC CCU SCR Project

Source	Regulatory Citation	Description	Emission Limit and/or Operational Restriction
DCRC CCU SCR Project	Regulation No. 1102	Permits	This regulation is applicable to the proposed project since these activities involve the installation of air pollution control equipment. This permit application is intended to meet DCRC's obligations under Regulation No. 1102. It includes the appropriate forms and other required information as outlined in Regulation No. 1102.
	Regulation No. 1103	Ambient Air Quality Standards	This regulation applies to the Delaware City Refinery as a whole, not to any specific process or emissions unit.
	Regulation No. 1104	Particulate Emissions from Fuel Burning Equipment	This regulation applies to the CCUs. The PM emissions from the CCUs will continue to be limited to an emission rate less than 0.3 lb/MMBtu.
	Regulation No. 1105	Particulate Emissions from Industrial Process Operations	This regulation is not applicable. The CCUs are subject to Regulation No. 1104.
	Regulation No. 1106	Particulate Emissions from Construction and Materials Handling	Sections 2 and 3 of this regulation are potentially applicable to project during the construction phase of the project. DCRC will ensure that construction activities comply with any applicable provisions of Regulation No. 1106.
	Regulation No. 1108	Sulfur Dioxide Emissions from Fuel Burning Equipment	Regulation No. 1108 is applicable. DCRC will ensure compliance with this regulation by limiting fuels combusted to desulfurized refinery fuel gas or natural gas.
	Regulation No. 1109	Emissions of Sulfur Compounds from Industrial Operations	This regulation is not applicable. The CCUs are subject to Regulation No. 1108.
	Regulation No. 1110	Emissions of Sulfur Compounds from Industrial Operations	This regulation is applicable to the project. Sulfur emissions (limited to combustion) from these units will be controlled by following the requirements of Regulation No. 1108.
	Regulation No. 1111	Carbon Monoxide Emissions from Industrial Process Operations New Castle County	Not Applicable. This regulation only applies to specific petroleum refinery processes.

Source	Regulatory Citation	Description	Emission Limit and/or Operational Restriction
DCRC CCU SCR Project	Regulation No. 1112	Control of Nitrogen Oxide Emissions	This regulation is applicable to the project. As described in this application, NO_x emissions will be subject to the facility-wide NO_2 PAL and NO_x cap.
	Regulation No. 1114	Visible Emissions	This regulation is applicable to the project. However, the refinery is already subject to this requirement and this project will not impact DCRC's compliance with this regulation.
	Regulation No. 1117	Source Monitoring, Recordkeeping and Reporting	The project will not affect the applicability of, or DCRC's compliance with the requirements of Regulation No. 1117.
	Regulation No. 1119	Control of Odorous Air Contaminants	This regulation applies. However, the refinery is already subject to this requirement and this project will not impact DCRC's compliance with this regulation.
	Regulation No. 1120	New Source Performance Standards	This regulation is not applicable. This project does not result in an increase in the hourly emission rate of a regulated pollutant; thus, by definition, it is not a modification under NSPS rules.
	Regulation No. 1124	Control of Volatile Organic Compound Emissions	This regulation is applicable to the project. Specifically, certain provisions of Section 29 are applicable.
	Regulation No. 1125	Requirements for Preconstruction Review	The level of emissions associated with the implementation of this project do not exceed the applicability levels contained in Regulation 1125. See Section 4.0 of the application for the analysis.
	Regulation No. 1147	CO_2 Budget Trading Program	The project will not affect the applicability of, or DCRC's compliance with the requirements of Regulation No. 1147.
	40 CFR 60 Subpart A	General Provisions	The NSPS general provisions codified at 40 CFR 60, Subpart A are applicable to stationary sources with facilities subject to any standard promulgated under Part 60. The proposed project will not affect the applicability of, or DCRC's compliance with the requirements of Subpart A.
	40 CFR 63 Subpart A	General Provisions	The NESHAP general provisions codified at 40 CFR 63, Subpart A are applicable to stationary sources with facilities subject to any standard promulgated under Part 63. The proposed project will not affect the applicability of, or DCRC's compliance with the requirements of Subpart A.

6.0 PROPOSED PERMIT CONDITIONS

The installation of SCR control on the CCUs will result in a potential increase of H_2SO_4 emissions as well as an expected potential NO_x emissions decrease of approximately 533 tons per year. However, DCRC is only seeking to amend the current H_2SO_4 permit limits in the Title V Permit, AQM-003/00016. As described in this application, the emissions from the CCUs are subject to facility-wide NO_x and NO_2 limits. Accordingly, no further limitations for NO_x are required as the project does not trigger NANSR for NO_x and the facility is subject to a reducing CAP for NO_x under DE Regulation 1142.

6.1 PROPOSED PERMIT CONDITIONS FOR CCUS

Table 6-1 below provides the proposed permit limits for the CCUs. Note the only proposed change to existing permit limits are for H_2SO_4 emissions.

Table 6-1 Summary of Proposed Permit Conditions for the CCUs

Pollutant	Current Permit Limits			
	CCU on NG without duct firing	CCU on NG with duct firing	Startup & Shutdown	Overall Limit
NO_x	15 ppmvd @ 15% O_2	18 ppmvd @ 15% O_2	390 ppmvd @ 15% O_2	- - -
SO_2	- - -	- - -	- - -	36.5 TPY
CO	0.0202 lb/MMBtu	0.0261 lb/MMBtu	- - -	110.9 TPY
PM_{10}	0.0074 lb/MMBtu	0.0099 lb/MMBtu	- - -	67.0 TPY
TSP	0.0115 lb/MMBtu	0.0112 lb/MMBtu	- - -	47.8 TPY
VOC	0.0021 lb/MMBtu	0.0046 lb/MMBtu	- - -	19.8 TPY
H_2SO_4	- - -	- - -	- - -	4.1 TPY
Pb	- - -	- - -	- - -	0.004 TPY

6.2 PROPOSED PERMIT CONDITIONS FOR AMMONIA

The installation of SCR controls on the CCUs will result in ammonia slip emissions. The proposed permit conditions are described below.

6.2.1 Emission Standard

NH_3 emissions from each CCU shall not exceed 10 ppmvd at 15% O_2 and 68.6 TPY.

6.2.2 Compliance Method

Compliance with the Emission Standard shall be based on the Monitoring/Testing requirements.

6.2.3 Monitoring/Testing

The Owner/Operator shall obtain weekly grab samples for ammonia from a location downstream of the SCR using a Department approved method. The Owner/Operator may request the Department approve less frequent monitoring if 24 consecutive sampling events indicate the ammonia slip to be less than 10 ppmvd @ 15% O_2.